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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/771,990	02/03/2004	Masahiko Furuno	09450/100K673-US2	3571

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EXAMINER	
ABOAGYE, MICHAEL	
ART UNIT	**PAPER NUMBER**
1793	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/771,990	FURUNO ET AL.	
	Examiner	Art Unit	
	Michael Aboagye	1793	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *06 November 2007*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *14, 16 - 28, 41 - 48 and 55 - 57* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *14, 16 - 28, 41 - 48 and 55 - 57* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 14, 17, and 20-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pedder et al. (US Patent No. 5,000,819) in view of Spence (US Patent No. 5,895,558).

Pedder et al. teaches an apparatus for forming a solder bump on a workpieces to be connected (flip chip components "9", see column 1, lines 15-19, figure and column 3, lines 48-51) including: a plasma generating means ("6", figure, and column 5, lines 45-50) adapted to generate at least hydrogen-containing plasma under a low pressure (column 3, lines 65-69 and column 4, lines 3-19); a gas supply means "7", (figure and column 3, lines 42-50) for feeding a process gas to the plasma generating chamber; a workpiece exposing means (the plate "2", see, column 3, lines 34-45) for exposing the solder alloy on the surface of the workpiece to the hydrogen-containing plasma (abstract and column 4, lines 10-19); and a heating means (electric heater platform "2', see column 3, lines 35-39) for supplying the heat input to cause the solder reflow ; wherein the reflow is conducted in a vacuum (column 3, lines 34-35).

Pedder et al. teaches, a high frequency power supply of 2.45 GHz and an electrode negatively biased with respect to the plasma (the earthed shield formed of perforated plate "8") (see (column 3, lines 44-46 and, lines 50-55; and column 4, lines 37-46).

shows in the figure a gas recovery means (see figure, exhaust valve "11"), said gas recovery means disposed such that the workpiece is positioned between the gas recovery means and the gas supply; said gas recovery causes the plasma to flow between the source electrode and the workpiece (see figure, and column 4, lines 37-46). Pedder et al. also teaches a movable platform "2", for positioning the workpiece and exposing the solder on the workpiece to the plasma (see, figure); an electric heater for generating heat for the solder reflow (column 4, lines 14-19).

The apparatus of Pedder et al. is equally capable of generating a fluorine containing plasma. The intended use of the instantly claimed apparatus is noted, however, the intended use does not patentably distinguish said claimed apparatus over the prior art. The intended use of the claims does not structurally limit the apparatus.

Pedder et al. does not expressly teach a hollow electrode body adapted to receive a process gas having supply openings for feeding process gas to the plasma chamber.

However Spence teaches an plasma generating apparatus adapted for treating surfaces or roughening surfaces of substrates including silicon (Spence, column 1, lines 15-20 and column 15, lines 15-20) comprising: a vacuum space, a high frequency power supply (Spence, column 2, lines 53-55), a heating means (16, figure 1 and

column 4, lines 50-55), process gas including hydrogen, oxygen, nitrogen, inert gases, water vapor and some fluorocarbons (e.g. CF_4) and other active gases (column 3, lines 14-28); and a hollow electrode body adapted to receive a process gas having supply openings for feeding process gas to the plasma chamber (Spence, column2, line 65 – column 3, line 4); wherein said holes in the electrode causes the process gas exiting therefrom to be turbulent flow status which improves mixing of the process gases and also enhances the removal of targeted the species from the substrate surface. The turbulent flow also improves temperature control of the gas phase (Spence, column 6, lines 40-52, and column 7, lines 9-12). Spence shows an apparatus in which the arrangement of the workpiece in relation to the pair of electrodes is similar to that of the applicant's i.e. the hollow electrode with a series of holes disposed below the workpiece. It is the examiners position that Spence is necessarily operable such that plasma ions generated from the process gas ejected from the supply openings, which are located opposite the workpiece, can be trapped and removed by the through holes, and thus preventing a violent collision of ions with the workpiece. In support of this assertion, the reference to Amemiya et al. (US 5,385,624) is cited to teach a plasma treatment apparatus including a hollow electrode with a series of hole which is operable in trapping plasma ions (column 4, lines 57-68, column 5, line 58-column 6, line 19).

It would have been obvious to one of ordinary skill in the art at the time the applicant's invention was made modified the apparatus of Pedder et al. to use teach a hollow electrode with perforated hole as taught by Spence in order to generate turbulence in the gas feed stream to improve mixing of the process gases, to enhance

the removal of targeted the species from the substrate surface and also improve temperature control of the gas phase (Spence, column 6, lines 40-52, and column 7, lines 9-12).

3. Claims 16 and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pedder et al. (US Patent No. 5,000,819) in view of Spence (US Patent No. 5,895,558) as applied to claim 14 above and further in view of Panitz et al. (US Patent No. 5,409,543).

Pedder et al. and Spence do not expressly teach heating means that is provided with a light source adapted to heat the backside of the workpiece by radiation and a reflecting mirror for adjusting luminous flux from the light source.

However Panitz et al. teaches a device for dry solder reflow, having plasma charged vacuum chamber and heating means for solder reflow including ohmic resistive heaters, lasers, and inductive heaters (Panitz et al., column 4, lines 50-64). Note that conventional laser heating devices are equipped with mirrors and lenses for the purpose of focusing the radiant heat or light to maximizing and localizing the heat input on the target.

It would have been obvious to one of ordinary skill in the art at the time the applicant's invention was made to have used in the combined teaching Pedder et al. and Spence, a laser heat source with adapted mirrors as taught by Panitz et al. since the ohmic resistive heaters and laser heaters are obvious alternatives known in the art (Panitz et al., column 4, lines 50-64)

4. Claim 19 is rejected under 35 U.S.C. 103(a) as being unpatentable over Pedder et al. (US Patent No. 5,000,819) in view of Spence (US Patent No. 5,895,558) as applied to claim 14 above and further in view of Frei et al. (US Patent No. 5,345,056).

Pedder et al. and Spence combined expressly teach a process a gas mixture consisting of hydrogen and argon, but do not expressly teach the relative compositions of the elements in the mixture.

However, Frei et al. teaches solder processing by using a gas plasma mixture containing an inert gas and hydrogen gas with hydrogen content of between 5-15%. (Note, this composition overlaps with the claimed range). Said hydrogen content selected to ensure an appreciable reduction of the surface oxides to improve wetting (Frei et al., column 4, lines 44-53).

It would have been obvious to one of ordinary skill in the art at the time the applicant's invention was made to have used an optimum content of hydrogen in the gas plasma mixture in the combined teaching of Pedder et al. and Spence as taught by Frei et al in order to reduce the surface oxides and to improve wetting of the substrate by the solder (Frei et al., column 4, lines 44-53).

5. Claims 23-25, 27, 28, 41-44, 46 and 47 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dishon et al. (US Patent No. 4,921,157) in view of Frei et al. (US Patent No. 5,345,056).

Dishon et al. teaches an apparatus and a method for forming bumps, which will serve as connecting terminals, on the surface of a workpiece comprising: roughening the surface of a soft solder alloy accumulated on the surface of the workpiece with oxygen plasma and then applying surface reforming treatment to form a layer containing fluorine on the roughened surface of the soft solder alloy; and performing reflow of the solder alloy that has undergone said surface reforming treatment (Dishon et al. column 5, lines 49-62); Dishon et al also teaches oxygenated plasma as a means of removing organic residues (column 5, lines 49-61); Dishon et al. further teaches a fluorine compound consisting of at least one of the compounds selected from among carbon fluoride compounds, sulfur hexafluoride and nitrogen trifluoride (Dishon et al. , column 2, lines 5-10 and column 3, lines 7-15).

Dishon et al. does not expressly teach roughening process using of the hydrogen and inert gas mixture.

Frei et al. teaches solder bump roughening by using inert gas and hydrogen plasma, with hydrogen content of between 5-15% (Frei et al., column 4, lines 44-53). Said hydrogen content selected to ensure an appreciable reduction of the surface oxides to improve wetting of the substrate by the solder (Frei et al., column 4, lines 44-53); wherein said plasma is able to generate chemical active species at low temperature thereby allowing the roughening process to be conducted at a low temperature (column 3, lines 49-62).

It would have been obvious to one of ordinary skill in the art at the time the applicant's invention was made to use hydrogen and inert gas mixture in the roughening

step of the Dishon et al. process since hydrogen and inert gas mixture is an obvious substitute for oxygen plasma, and a plasma source which avoids the risks associated with oxygen plasma such as limited accuracy and penetration, potential damage to the substrate and components and high tendency to badly oxidizing the solder (Frei et al., column 2, lines 25-28 and 36-41).

6. Claim 26 is rejected under 35 U.S.C. 103(a) as being unpatentable over Dishon et al. (US Patent No. 4,921,157) in view of Frei et al. (US Patent No. 5,345,056) as applied to claim 24 above and further in view of Panitz et al. (US Patent No. 5,409,543).

Neither Dishon et al. nor Frei et al. teach argon as the applied inert gas.

However, Panitz et al. teaches a surface roughening process by using a plasma containing hydrogen and inert gas mixture; wherein the inert gas is one of nitrogen or argon (Panitz et al., column 56, lines 39-49).

It would have been obvious to one of ordinary skill in the art at the time the applicant's invention was made to have used hydrogen /argon plasma in the combined process of Dishon et al. and Frei et al. as taught by Panitz et al. since nitrogen and argon are both inert gases and can obviously be substituted for each other (Panitz et al., column 56, lines 39-49).

7. Claims 45 and 48 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dishon et al. (US Patent No. 4,921,157) in view of Frei et al. (US Patent No.

5,345,056) as applied to claim 43 and 46 above and further in view of Tsao (US Patent No. 6,288,451).

Dishon et al. and Frei et al. do not expressly teach, a soldering apparatus operable in executing mechanical roughening.

However, Tsao teaches mechanical (or chemical) roughening as a means of improving adhesion and therefore bonding between surfaces (Tsao, column 3, lines 52-62).

It would have been obvious to one of ordinary skill in the art at the time the applicant's invention was to employ mechanical roughening in the combined teaching of Dishon et al. and Frei et al as taught by Tsao since chemical and mechanical roughening are obvious alternatives each of which promotes surface adhesion and bond strength by at least 10 % (Tsao, column 3, lines 52-62).

8. Claim 55 is rejected under 35 U.S.C. 103(a) as being unpatentable over Dishon et al. (US Patent No. 4,921,157) in view of Frei et al. (US Patent No. 5,345,056) as applied to claim 24 above and further in view of Wolf et al. (US Patent No. 6,095,397).

Dishon et al. and Frei et al. do not expressly teach a specific roughness number achieved during the roughening step.

Wolf et al. teaches a coating of solder provided with roughness in the range 3 to 5 microns; wherein said roughness provides reliable adhesion (Wolf et al., column 3, lines 40-50).

It would have been obvious to one of ordinary skill in the art at the time the applicant's invention was made to provide the roughness height at least 3 microns in the combines invention of Dishon et al., and Frei et al. as taught by Wolf et al., to obtain good adhesion of solder deposit on a target surface (Wolf et al., column 3, lines 40-50).

9. Claims 56 and 57 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dishon et al. (US Patent No. 4,921,157) in view of Frei et al. (US Patent No. 5,345,056) and Tsao (US Patent No. 6,288,451) as applied to claim 45 and 48 above and further in view of Wolf et al. (US Patent No. 6,095,397).

Dishon et al., Frei et al. and Tsao do not expressly teach a specific roughness number achieved during the roughening step.

Wolf et al. teaches a coating of solder provided with roughness in the range 3 to 5 microns; wherein said roughness provides reliable adhesion (Wolf et al., column 3, lines 40-50).

It would have been obvious to one of ordinary skill in the art at the time the applicant's invention was made to provide the roughness height at least 3 microns in the combines invention of Dishon et al., Frei et al. and Tsao as taught by Wolf et al., to obtain good adhesion of solder deposit on a target surface (Wolf et al., column 3, lines 40-50).

Response to Arguments

10. The examiner acknowledges the applicants' amendment received by USPTO on November 06, 2007. Claim 14, 16-28, 41-48 and 55-57 remain under consideration in the application.

11. Applicant's arguments filed November 06, 2007 have been fully considered but they are not persuasive. Applicant argues that Pedder et al. disclosure of a microwave shield fails to include or suggest each of the claimed element in the Applicant's electrode. The Examiner agrees with the applicant that Pedder et al. fail to teach a hollow electrode with a series of holes and the associated features as set forth in the claims. It is noted however that, the examiner stated clearly stated such position in the prior office action, paragraph 2, page 3. Applicant's is also reminded that Pedder et al. teaches the same high frequency power i.e. 2.45 GHz as set forth in the claims. Spence provides the remedy for the deficiencies of Spence by disclosing a hollow electrode with a series of holes to ensure uniform distribution of the process gas. Spence shows an apparatus in which the arrangement of the workpiece in relation to the pair of electrodes is similar to that of the applicant's i.e. the hollow electrode with a series of holes disposed below the workpiece. It is the examiner's position that Spence apparatus is necessarily operable such that plasma ions generated from the process gas ejected from the supply openings, which are located opposite the workpiece, can be trapped and removed by the through holes, and thus preventing a violent collision of ions with the workpiece. In support of this assertion, the reference to Amemiya et al. (US

5,385,624) is cited to teach a plasma treatment apparatus including a hollow electrode with a series of hole which is operable in trapping plasma ions (column 4, lines 57-68, column 5, line 58-column 6, line 19).

Applicant admits that Frei et al. discloses a plasma-based soldering process in which the plasma forming gas contains hydrogen and an inert gas (nitrogen). However Applicant argues that Frei et al. in nowhere discloses or suggests that the plasma is applied for the purpose of roughening the surface of a solder alloy, and goes on to argue that Frei et al. suggests that the generated plasma species are "not reactive enough to perform etching except on some materials, and that Frei et al. teaches mere cleaning. The examiner disagrees with Applicant's characterization of Frei et al. reference. Frei et al. specifically teaches generating chemically active species in a plasma chamber (column 3, lines 49-62), and furthermore teaches the same process gas as Applicant (i.e. hydrogen and inert gas mixture, see, Frei et al. column 4, lines 30-68). It is the Examiner's position that, even though Frei et al. is silent on using the word roughening, by operating with the same process gas under the same plasma generating conditions the method of Frei et al. necessarily produces reactive enough species to cause surface roughening of the substrate. Frei et al. mentions etching in his plasma treatment, the examiner believes that etching involved roughening of the substrate.

Conclusion

12. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

13. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Michael Aboagye whose telephone number is 571-272-8165. The examiner can normally be reached on Mon - Fri 8:30am - 5pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jonathan Johnson can be reached on 571-272-1177. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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01/07/2008